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Project Summary for  
An Application from  
Archer Daniels Midland, Decatur for  
A Revised Construction Permit/PSD Approval for  
Coal-Fired Boiler 9

Site Identification No.: 115015AAE  
Application No.: 97050097

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Important Dates

Comment Period Begins: August 1, 2006  
Comment Period Closes: August 31, 2006

## I. INTRODUCTION

Archer Daniels Midland Company (ADM) has applied for revisions to certain provisions of the Construction Permit for its Boiler 9, a coal-fired boiler. ADM operates this boiler, along with other boilers, at its complex in Decatur to supply steam and electricity to its grain processing and manufacturing operations.

ADM has applied for revisions to certain provisions of the Construction Permit for Boiler 9 that set Best Available Control Technology (BACT) for emissions of nitrogen oxides (NO<sub>x</sub>) and carbon monoxide (CO), as those provisions currently apply to startup and shutdown of the boiler. The Illinois EPA has reviewed ADM's request and determined that ADM is entitled to a revised permit for Boiler 9. During startup and shutdown of the boiler, ADM cannot operate the boiler to achieve the same rates of NO<sub>x</sub> and CO emissions that it can achieve when the boiler is operating in the normal load range. This is because of constraints that are inherent in the physical design of the boiler and affect the rate of emissions during startup and shutdown. As a result, an alternate approach to BACT for emissions of NO<sub>x</sub> and CO is appropriate for Boiler 9 to address periods of startup and shutdown.

The Illinois EPA has prepared a draft of the revised construction permit that it proposes to issue to ADM. However, before issuing a revised permit, the Illinois EPA is holding a comment period to receive comments from the public on the proposed issuance of a revised permit and the terms and conditions of the draft revised permit.

## II. BACKGROUND

Boiler 9 is a circulating fluidized bed (CFB) boiler that began operation in October 2001. The primary fuel for the boiler is high sulfur Illinois coal. Limestone is injected into the fluidized bed of the boiler, along with the coal fuel, for control of emissions of sulfur dioxide (SO<sub>2</sub>). Good combustion practices are used for control of emissions of CO and volatile organic material (VOM). The boiler is equipped with an add-on selective non-catalytic reduction (SNCR) system, which injects ammonia into the cyclone section at the top of the boiler, for control of emissions of NO<sub>x</sub>. A fabric filter or baghouse is used for control of emissions of particulate matter (PM).

Boiler 9 is subject to state emission standards for new large solid fuel-fired boilers. It is subject to the federal New Source Performance Standards (NSPS) for Industrial, Commercial and Institutional Steam Generating Units, 40CFR 60 Subpart Db. Boiler 9 was subject to permitting under the federal rules for Prevention of Significant Deterioration (PSD), 40 CFR 52.21, because the project had the potential to emit significant amounts of various PSD pollutants, including NO<sub>x</sub> and CO.

Boiler 9 was constructed pursuant to Construction Permit/PSD Approval 97050097. In addition to Boiler 9, this permit also covered two other proposed boilers that were not been constructed (proposed Boiler 10, a second CFB boiler, and proposed Boiler 11, a natural gas-fired boiler) and various changes to the coal and limestone handling and storage systems associated with the coal-fired boilers.

### III. REQUESTED REVISION FOR NO<sub>x</sub> EMISSIONS

The original permit for Boiler 9 set a BACT limit for NO<sub>x</sub> emissions in terms of lbs NO<sub>x</sub>/million Btu heat input to the boiler, with compliance determined as a rolling 30-day average including periods of startup, shutdown and malfunction. The specific numerical limit depends upon the sulfur content of the fuel supply to the boiler, with the separation between low and high sulfur coal at 2.5 lbs sulfur per million. One BACT limit is set for when the coal supply to the boiler qualifies as low sulfur coal and another, higher limit is set for use of high sulfur coal. In addition, ADM was required to perform an optimization study to determine if still lower NO<sub>x</sub> limits might be reliably achieved. However, as will be discussed later, since ADM did not perform this study, Boiler 9 is subject to the default BACT limits contained in the original permit that take effect if an optimization study is not completed.

The inclusion of startup emissions in the compliance determination for the current BACT limit can make compliance with the current limit infeasible. During startup of Boiler 9, the rates of NO<sub>x</sub> emissions, in lbs/million Btu, are significantly higher than during normal operation. When the higher NO<sub>x</sub> emissions from startup are factored into a 30-day average emission rate to determine compliance, in accordance with the procedures of the NSPS, the NO<sub>x</sub> emission rate can exceed the applicable BACT limit. Although the emissions of the boiler comply with the numerical BACT limit when the boiler is operating normally, there is not necessarily sufficient over compliance to compensate for the “extra” emissions that occur during startup. The ability to comply depends on the number, nature and duration of the startups of Boiler 9 during each 30-day compliance time period, with protracted or multiple startups making compliance increasingly less certain.

During any particular startup of Boiler 9, ADM’s objective is to safely and quickly bring the boiler up to normal operating temperature so that the boiler can start to productively generate steam. Within these constraints, ADM does not have a desire to prolong any individual startup. In addition, ADM’s operational goal for Boiler 9 is to have a minimum number of startups during the course of a year. ADM indicates that in a normal year, there will likely be only two planned shutdowns for scheduled maintenance. Any other outages would be unscheduled and potentially disrupt operations at the complex, as the steam supply for the complex would be unexpectedly reduced. However, because of the nature of a CFB boiler, ADM cannot assure that multiple startups will not occur within a single 30-day period or events occur during a particular startup that prolong or delay the completion of the startup.

As a technical matter, the consequences of startup for NO<sub>x</sub> emissions can be related back to features that are inherent in the design and operation of a CFB boiler and use of SNCR to control NO<sub>x</sub> emissions. During a cold startup, as occurs after any major outage of a boiler, Boiler 9 is preheated with natural gas before coal is introduced into the boiler. Limestone and other non-fuel materials are gradually added to the fluidized bed and also heated in preparation for the introduction of coal. The SNCR cannot be operated to control NO<sub>x</sub> emissions during these phases of startup because the flue gas temperature is still too low, gas flow rates are increasing, and NO<sub>x</sub> emission levels in the flue gas are not stable. Effective operation of an SNCR system requires stable flue gas flows and temperatures in excess of 1500 °F to assure that the injected

ammonia reacts with NO<sub>x</sub> and does not “slip” through without reacting with NO<sub>x</sub>, potentially contributing to additional emissions of particulate matter. Some operation of the boiler on coal is required before ammonia injection into the flue gas for NO<sub>x</sub> control can begin. Before the conditions in the boiler are suitable for operation of SNCR system, the rate of uncontrolled NO<sub>x</sub> emissions is greater than the numerical limit set as BACT, as the BACT determination was premised upon the ability to operate the SNCR system for effective control of NO<sub>x</sub> emissions. The implications of these startup emissions are significant, as a cold startup of the boiler can take up to 48 hours, so that a single startup could affect three out of the 30 days in a single compliance time period.

As a matter of arithmetic, these circumstances also arise because compliance with the BACT limit for NO<sub>x</sub> emissions from Boiler 9 is to be determined using the compliance procedures of the NSPS. The NSPS requires compliance to be determined using a 30-day average of daily NO<sub>x</sub> emission rates, expressed in lbs/million Btu. The NSPS does not determine compliances based on the actual emission rate across the entire 30-day period, calculated by dividing the total mass of NO<sub>x</sub> emissions during the period (pounds) by the total heat input (million Btu), to yield an actual average NO<sub>x</sub> emission rate in lbs/million Btu. In other words, under the compliance procedures of the NSPS, as are applicable to the NO<sub>x</sub> BACT limit, days in which Boiler 9 is in startup and the NO<sub>x</sub> emission rate in lb/million Btu is high, are given the same weight as “normal” days when the NO<sub>x</sub> emission rate is within the BACT limit. This takes place even though Boiler 9 is operating at much lower loads and lower amounts of NO<sub>x</sub> emissions on the startup days as compared to the “normal” days. The nature of the specified compliance procedures is significant for the NO<sub>x</sub> BACT limits for Boiler 9, as those limits are in the range of 0.07 to 0.12 lbs/million Btu. This effect does not arise for the NSPS standard for NO<sub>x</sub>, even though the NSPS standard applies to all emissions in the 30-day compliance time period. This is because the applicable NSPS standard is much higher than the BACT limit, i.e., 0.60 lbs/million Btu. The NO<sub>x</sub> emissions of Boiler 9, even including startup and using the compliance procedures of the NSPS, are well within 0.60 lb/million Btu.

The BACT determination made for Boiler 9 already includes requirements to use reasonable practices to minimize NO<sub>x</sub> emissions from the boiler during startup and shutdown, including implementation of certain specified work practices to minimize emissions during startup. An alternate approach, which limits the amount of NO<sub>x</sub> emissions, in lbs/hour, rather than the rate of NO<sub>x</sub> emissions, in lbs/million Btu, can be used for a numerical BACT limit that includes periods of startup. An alternate limit is most directly set at a value that is calculated as the product of the design heat input capacity of the boiler (1500 million Btu/hour) and the generally applicable BACT limit. For example, if Boiler 9 is generally subject to a BACT limit of 0.1 lb/million Btu, the alternate BACT limit that would also include periods of startup would be 150 pounds/hour ( $1500 \times 0.10 = 150$ ). The original BACT limit would be retained, unchanged, for 30-day compliance time periods, excluding startups. This approach to NO<sub>x</sub> emission during periods of startup combines the low operating rate of the boiler during such periods with the potentially higher rate of emissions to maintain to a limit that addresses startup that is still equivalent to the amount of emissions that is generally allowed during normal operation of Boiler 9. It also preserves both the numerical value and form of the original BACT limit for Boiler 9 in the circumstances in which it is appropriate, which will in actual practice continue to address the majority of the operation of Boiler 9.

The Illinois EPA considered and rejected three other alternatives for the revision to the BACT determination for Boiler 9: 1) Reliance solely on work practices as BACT for startup, without a numerical BACT emission limit; 2) An upward revision of the BACT limit to maintain the current compliance procedures while including startup emissions; and 3) A switch to mass-based compliance procedures, with no change or a possible reduction in the numerical BACT limit. These alternatives were generally rejected because they were not needed to address the issue posed for the BACT determination for NO<sub>x</sub> by startup emissions, as the original BACT determination could reasonably be adapted to also address startup emissions, as discussed above. In particular, the Illinois EPA did not consider it necessary or appropriate to raise the BACT limit for NO<sub>x</sub> to address these circumstances. Based on the emission data provided by ADM, a single two day cold startup could add about 0.03 lbs/million Btu to the 30-day average NO<sub>x</sub> emission rate calculated according to NSPS procedures. To comply with a NO<sub>x</sub> BACT limit of 0.12 lb/million Btu, Boiler 9 could need to average 25 percent lower than the normally applicable BACT limit, e.g., 0.09 lbs/million Btu, during the remaining 28 days of the compliance time period. Thus if the generally applicable NO<sub>x</sub> BACT limit continued to include startup emissions, the BACT limit would have to be raised to provide a compliance margin of 0.03 to 0.04 lbs/million Btu, on top of whatever emission rate can be demonstrated during normal operation to allow for the possibility of multiple startups during a particular 30-day period. Rather than raise the BACT limit in this manner, it is more appropriate to establish an alternative BACT limit to address NO<sub>x</sub> emissions during startup.

#### IV. REQUESTED REVISION FOR CO EMISSIONS

The BACT limit for Boiler 9 for emissions of CO in the original construction permit is 0.10 lbs/million Btu, 3-hour average, applicable at all times, including periods of startup. The emission data collected by ADM indicates that Boiler 9 readily complies with this BACT limit during normal operation. However, as with emissions of NO<sub>x</sub>, this limit cannot be reliably met during startup. During the warm-up phase of startup, when only natural gas is fired during startup, CO emissions typically average about 0.4 lbs/million Btu on an hourly basis. During the transition phase, when both gas and coal are being fired, CO emissions typically average about 0.8 lbs/million Btu on an hourly basis, with a great deal of variability as the coal feeders are started one at a time. When the transition to coal firing is completed and firing of natural gas is discontinued, CO emissions are typically within 0.10 lbs/million Btu, the numerical BACT limit. Accordingly, the ability to meet the BACT limit depends upon the timing of the startup. Any unforeseen events or delays during the initial phases of startup can easily result in noncompliance, as cold startups of the boiler can take up to 48 hours.

The circumstances of the boiler during startup are understandable given the design and operation of a CFB boiler. The key feature of the CFB boiler is the fluidized combustion bed, which is suspended by the flow of combustion air introduced below the bed at the bottom of the boiler. This prevents the supplemental natural gas fired burners used during startup from being placed at a location in the boiler where combustion air for those burners can be managed as necessary to meet the BACT limit for CO. Similarly, the need to fluidize the bed requires a rate of air flow to the bed that is not the same as that needed for efficient combustion of coal at low firing rates, as present during startup. Thus, startup involves a complex transition in the rates of air flow needed

for combustion of natural gas, combustion of coal, and fluidization of the combustion bed, during which the operational conditions necessary to comply with a CO emission limit of 0.10 lbs/million Btu cannot be readily assured. Similar constraints are also present during planned shutdowns of the boiler, as various air flow rates and the fluidized bed are gradually reduced.

The BACT determination made for Boiler 9 includes requirements to use reasonable practices to minimize emissions from the boiler during startup and shutdown, including implementation of certain specified work practices to minimize emissions. As with BACT for NO<sub>x</sub>, an alternate approach, which limits the amount of CO emissions, in lbs/hour, rather than the rate of CO emissions, in lbs/million Btu, can be used for the numerical BACT limit during periods of startup. An alternate limit is most directly set at 0.150 lbs/hour, calculated as the product of the design heat input capacity of the boiler (1500 million Btu/hour) and the generally applicable BACT limit (0.1 lb/million Btu). This approach to CO emission during periods of startup combines the low operating rate of the boiler during such periods with the potentially higher rate of emissions to maintain to a limit that is still equivalent to the amount of emissions that is generally allowed during normal operation of the boiler. This limit is more appropriately set as a 24-hour average, rather than a 3-hour average, to be consistent with the duration of startup events. A longer compliance time period is feasible because ADM is required to conduct continuous emissions monitoring for CO emissions from Boiler 9.

For ease of implementation of the BACT limit for CO emissions for Boiler 9, the BACT limit for normal operation will also be shifted to a 24-hour compliance time period. This also provides consistency with other subsequent BACT determinations for CO emissions from coal-fired boilers made by the Illinois EPA, which apply on a 24-hour basis, e.g., the new CFB boiler being installed by Corn Products in Bedford Park.

## V. AIR QUALITY IMPACTS

The proposed changes to the BACT limits for Boiler 9 for NO<sub>x</sub> and CO emissions do not significantly affect the air quality impacts of Boiler 9. This is because Boiler 9 does not have significant impacts on air quality for either NO<sub>x</sub> or CO, as was shown in the dispersion modeling submitted by ADM as part of the original construction permit application. A copy of those results is provided below. It should be noted that these results below actually overstate the impact of Boiler 9 on air quality for NO<sub>2</sub>, as they account for the higher level of NO<sub>x</sub> emissions originally permitted from Boiler 9. These results also include the impacts of proposed Boilers 10 and 11, which ADM never constructed.

Table 1: Summary of Peak Project Impacts from Construction Permit Application 97050097  
(Maximum impacts in micrograms per cubic meter, i.e., ug/m<sup>3</sup>)

Pollutant	Averaging Period	Maximum Project Impact	Significant Impact Level (SIL)	Ambient Standard
CO	1-Hour	29.45	2,000	40,000
	8-Hour	11.59	500	10,000
NO <sub>2</sub>	Annual	0.483	1	100

## VI. DRAFT PERMIT

The draft permit includes changes to the BACT limits for NO<sub>x</sub> and CO, as discussed above. As previously mentioned, the BACT limits for NO<sub>x</sub> are also set at the lower, “default” limits that are applicable if ADM does not conduct an optimization study for NO<sub>x</sub> emissions. These lower default limits are 0.10 and 0.07 lbs/million Btu for high and low sulfur coal respectively, as compared to the original limits of 0.12 and 0.09 lbs/million Btu, respectively. These changes have been made because ADM did not conduct the optimization study that would have been needed to justify and retain the higher set of BACT limits for NO<sub>x</sub> emissions. After completion of an extended period of shakedown and initial operation for Boiler 9, including various physical alterations of the boiler to correct design flaws that prevented achievement of its design load capacity, ADM determined that Boiler 9 could generally meet the lower BACT limits for NO<sub>x</sub> emissions. Accordingly, ADM elected not to undertake the optimization study. However, ADM’s decision was linked to appropriate resolution of the technical issue posed for NO<sub>x</sub> emissions by startup of the boiler. While this issue is posed for both sets of BACT limits, the effect of startup on 30-day average emission rates is more critical for the lower set of NO<sub>x</sub> limits, which act to both increase the “extra” NO<sub>x</sub> emissions from the startup itself and reduce the ability to generate “credits” during the rest of the 30-day compliance time period make up for the NO<sub>x</sub> emission rates during startup.

Since the provisions for performance of an optimization study for NO<sub>x</sub> emissions from Boiler 9 have been dealt with and are no longer relevant, these provisions are not included in the draft permit. The draft permit also lowers the permitted emissions of NO<sub>x</sub> from Boiler 9 on an annual and short-term basis, with an annual reduction in permitted emissions of NO<sub>x</sub> of over 100 tons per year. This adjustment is a consequence of applying the new BACT limit for NO<sub>x</sub> for high sulfur coal (0.10 lbs/million Btu) to the operation of Boiler 9, which would be the higher NO<sub>x</sub> emission rate that would be allowed under the revised permit, rather than the original limit for high sulfur coal (0.12 lbs/million Btu).

The draft permit also does not include the provisions for Boilers 10 and 11 that were contained in the original permit, as these boilers were not constructed. This is because the authorization to construct these units provided by the original permit lapsed when ADM did not begin a program of continuous construction within 18 months of the effectiveness of the permit that included these boilers. If ADM would now decide to build either of these proposed boilers, it would have to obtain a new construction permit for the project.

## VII. REQUEST FOR COMMENTS

It is the Illinois EPA's preliminary determination that the revised permit requested by ADM would meet all applicable state and federal air pollution control requirements. The Illinois EPA is therefore proposing to issue a revised permit

Comments are requested on this proposed action by the Illinois EPA and the proposed conditions on the draft permit. If substantial public interest is shown in this matter, the Illinois EPA will consider holding a public hearing.